Advanced Process Control Library V2.0

APC Standard Library
PES Templates Offer User Manual

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Failure to use Schneider Electric software or approved software with our hardware products may result in injury, harm, or improper operating results.

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Safety Information

Important Information

NOTICE

Read these instructions carefully, and look at the equipment to become familiar with the device before trying to install, operate, or maintain it. The following special messages may appear throughout this documentation or on the equipment to warn of potential hazards or to call attention to information that clarifies or simplifies a procedure.

The addition of this symbol to a Danger safety label indicates that an electrical hazard exists, which will result in personal injury if the instructions are not followed.

This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

⚠ DANGER

DANGER indicates an imminently hazardous situation which, if not avoided, **will result in** death or serious injury.

⚠ WARNING

WARNING indicates a potentially hazardous situation which, if not avoided, **can result in** death or serious injury.

⚠ CAUTION

CAUTION indicates a potentially hazardous situation which, if not avoided, **can result in** minor or moderate injury.

NOTICE

NOTICE is used to address practices not related to physical injury.

PLEASE NOTE

Electrical equipment should be installed, operated, serviced, and maintained only by qualified personnel. No responsibility is assumed by Schneider Electric for any consequences arising out of the use of this material.

A qualified person is one who has skills and knowledge related to the construction and operation of electrical equipment and its installation, and has received safety training to recognize and avoid the hazards involved.

About the Book

At a Glance

Document Scope

This document describes the templates that are included in the PES software, and the Unity Pro and Vijeo Citect services.

For a more detailed description of the associated Unity Pro and Vijeo Citect services and configuration parameters, refer to the user manuals mentioned in this document.

NOTE: This document does not cover any development procedures and internal functionality details.

Validity Note

This manual is valid for Process Expert V3.1 SP1.

Related Documents

Title of Documentation	Reference Number
Advanced Process Control Library V2.0, APC Standard Library PES Control and Supervision Services Offer User Manual	EIO0000001323
Process Expert, Process Template Control Services User Guide	EIO0000000988
Process Expert, Process Templates User Guide	EIO0000000987

You can download these technical publications and other technical information from our website at www.schneider-electric.com.

Product Related Information

⚠ WARNING

LOSS OF CONTROL

Review potential failure modes of the control paths for critical control functions.

Provide a means to achieve a safe state during and after a path failure.

Provide separate or redundant control paths for critical control functions.

Review the implications of transmission delays or failure of communication links.

Apply local accident prevention and safety regulations and guidelines. [1]

Test each implementation of this library for proper operation before placing it into service.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

[1] For additional information, refer to NEMA ICS 1.1 (latest edition), Safety Guidelines for the Application, Installation, and Maintenance of Solid State Control and to NEMA ICS 7.1 (latest edition), Safety Standards for Construction and Guide for Selection, Installation and Operation of Adjustable-Speed Drive Systems or their equivalent governing your particular location.

The application of this product requires expertise in the design and operation of control systems.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Allow only authorized personnel with such expertise to program, install, alter, and apply this product.

Follow local and national safety codes and standards.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Examples in this manual are given for information only.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Adapt examples that are given in this manual to the specific functions and safety requirements of your industrial application when you implement them.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

Part I

General Overview of Advanced Process Control Library V2.0 for PES Offer

Chapter 1
General Information

Introduction

Overview

The APC library V2.0 for PES system consist of 3 advanced libraries:

- APC Standard Library
- PCR Library
- IMC Library

You can use any of these above mentioned libraries as per the requirement. APC Standard Library has PID controllers and other auxiliary function blocks with advanced features such as loop back in/back out functionality.

The PCR Library consists of the predictive controller function blocks for simple and integrative first order processes. IMC Library consists of the internal model-based controller function blocks for simple and integrative first order processes.

This document mainly gives the information about the APC Standard Library PES templates. This document provides resources that are pre-configured and tested by Schneider Electric.

The control resources for Unity and the monitoring resources for Vijeo Citect provide the commonly required functions.

The system provides derived function blocks (DFB) for control and also provides dynamic representations (genies and faceplates) for monitoring.

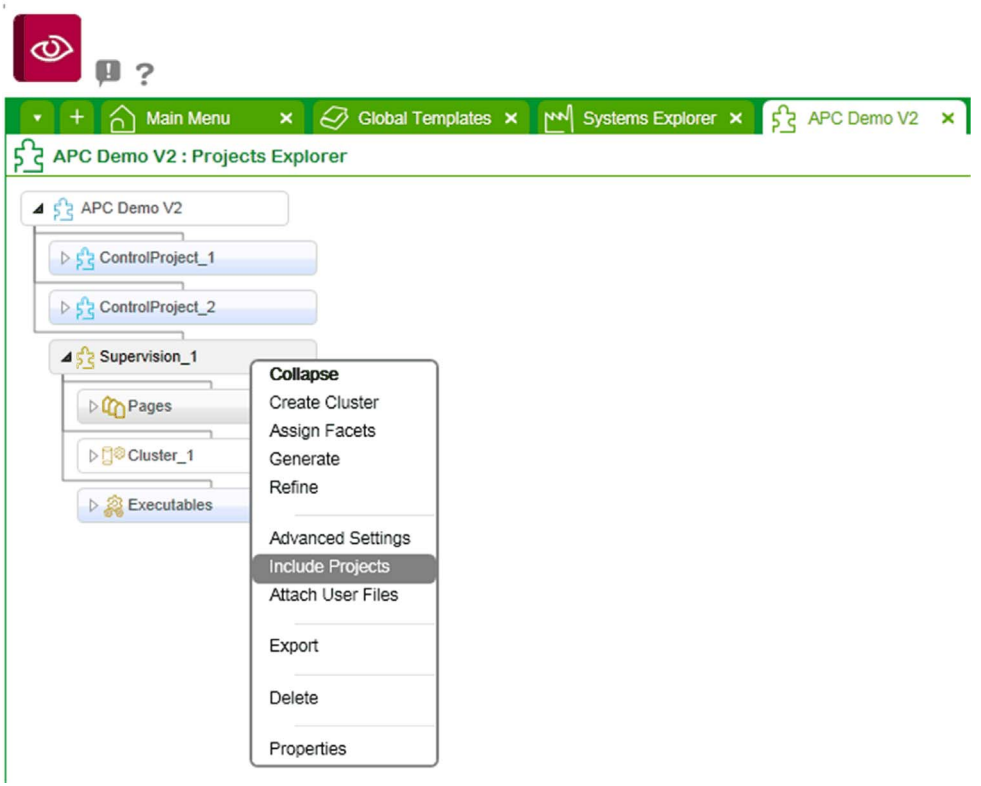
To automate and simplify the implementation of control systems, you can use these resources together with tools for massive code generation and for the synchronization of control and monitoring subsystems.

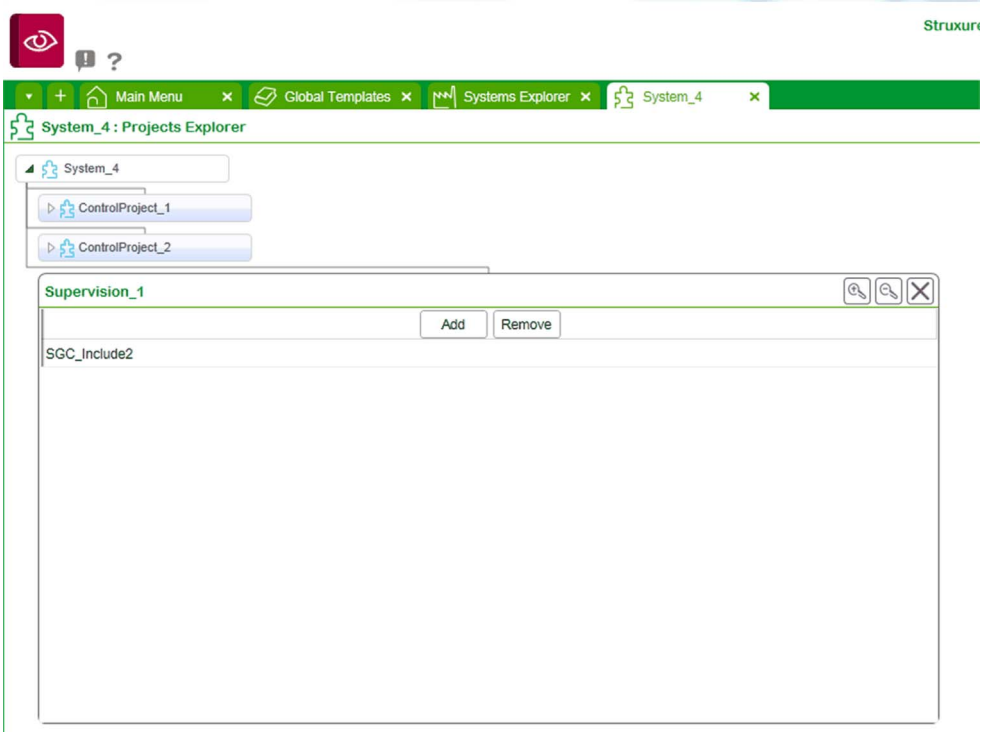
The APC library objects are designed to perform complex close loop control algorithm-related functions. These are defined as generic process blocks that are designed for complex calculations and control loops.

This document establishes the composition for creating the templates of standard libraries.

Generic Information

If you are generating a Supervision project with only APC Library blocks, then include *SGC_Include2.ctz* in the following steps manually:

Step	Action
1	Right-click the Supervision project and select **Include Projects**. 

Step	Action
2	Add *SGC_Include2.ctz* file from local system. 

Part II
Advanced Process Control Library Templates

Overview

This chapter describes the Advanced Process Control library templates.

What Is in This Part?

This part contains the following chapters:

Chapter	Chapter Name	Page
2	Template Overview	17
3	List of Templates	19
4	Template Description	21
5	Use Case Examples	69

Chapter 2
Template Overview

Advanced Process Control Templates

Overview

The APC library objects are designed to perform complex close loop control algorithm-related functions. This library consists of advanced PID controllers with in-built auto-tune functionality. These are defined as generic process blocks that are designed for complex calculations and control loops.

You can use this library objects with PES system library objects and any of the available segment specific libraries. For example, General Purpose Library, Water Library, LVPC Library, and so on. You can find a list of templates in section List of Templates *(see page 19)*.

Composition

The control module templates are composed of composite and facet templates, which encapsulate constituents to provide 1 or more of the following services:

- Control core and optional services
- Supervision

NOTE: These services complement the control services. Supervision services are optional.

Chapter 3
List of Templates

Template List Organized by Category

Templates List

The templates described in this document are grouped under a single family.

The following table provides the names and descriptions of the templates:

Template Name	Description
AP_AA *(see page 23)*	Analog Acquisition block.
AP_AP *(see page 28)*	Analog Positioner block.
AP_FSP *(see page 43)*	Setpoint block.
AP_PID *(see page 33)*	PID block.
AP_EPID *(see page 38)*	Enhanced PID block.
AP_CH *(see page 46)*	Choice block.
AP_DM *(see page 48)*	Demultiplexer block.
AP_RATIO *(see page 50)*	Ratio block.
AP_VOTE *(see page 52)*	Vote block.
AP_SEL *(see page 54)*	Selection block.
AP_SPLIT *(see page 56)*	Split block.
AP_WRAP_AP *(see page 56)*	Wrapper for Analog Positioner block.

The following table provides the names and descriptions of the HAL templates:

Template Name	Description
AP_HAL_AI_UC *(see page 61)*	Hardware Abstraction Layer for Analog Acquisition block template.
AP_HAL_AP_UC *(see page 62)*	Hardware Abstraction Layer for Analog Positioner block template.
AP_HAL_AnalogAcquisition_UL *(see page 63)*	Unity Logic template - Unity Composite of AP_HAL_AI_UC template.
AP_HAL_AnalogPositioner_UL *(see page 64)*	Unity Logic template - Unity Composite of AP_HAL_AP_UC template.

The following table provides the names and descriptions of the structure data type template:

Template Name	Description
PV_VC_UL *(see page 66)*	Unity Logic template for PV_VC structure data type.
UCREATE_PV_VC_UL *(see page 67)*	Unity Logic template for UCREATE_PV_VC packing default value.
UEXTRACT_PV_VC_UL *(see page 68)*	Unity Logic template for UEXTRACT_PV_VC extracting default value.

Chapter 4
Template Description

Overview

This chapter describes the template, lists the templates, and describes about the each control module, HAL, and structure data templates of the Advanced Process Control library.

What Is in This Chapter?

This chapter contains the following sections:

Section	Topic	Page
4.1	Control Module Templates	22
4.2	Hardware Abstraction Layer Templates (Signal Objects)	60
4.3	Structure Data Type Template	65

Section 4.1
Control Module Templates

Overview

This chapter describes the control module templates of the Advanced Process Control library.

What Is in This Section?

This section contains the following topics:

Topic	Page
AP_AA: Analog Acquisition Block	23
AP_AP: Analog Positioner Block	28
AP_PID: PID Block	33
AP_EPID: EPID Block	38
AP_FSP: Setpoint Block	43
AP_CH: Choice Block	46
AP_DM: Demultiplexer Block	48
AP_RATIO: RATIO Block	50
AP_VOTE: Vote Block	52
AP_SEL: Selection Block	54
AP_SPLIT: Split Block	56
AP_WRAP_AP: Wrapper for Analog Positioner Block	58

AP_AA: Analog Acquisition Block

General Description

The AP_AA process control module template is used as an interface with an analog input to set up an analog measurement.

The process template provides simple hardware interface with an analog input.

Composition

The process control module template AP_AA is composed of composite and facet templates, which provide the following services:

Control: Includes core services plus additional, optional services, which you can activate if needed.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_AA control module and the corresponding facet, which implements the service:

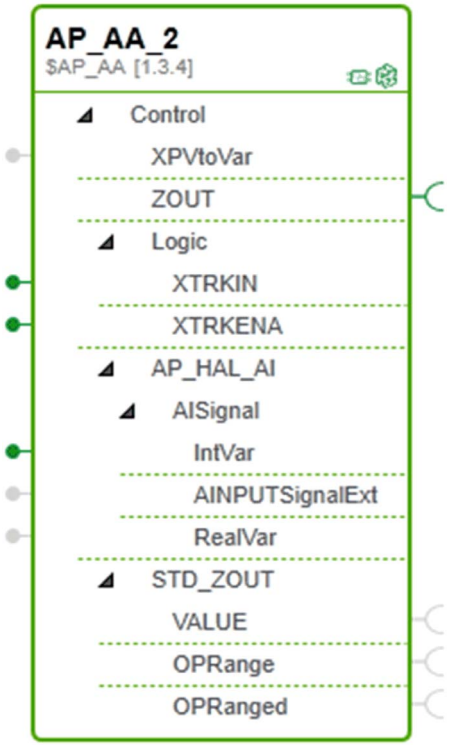
Control Services ($AP_AA_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_AA_CS)*	Corresponding Supervision Templates		Supervision Service Description
Core Services							
Logic*	–	$AP_AA_UL	Refer to the AP_AA block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Analog acquisition supervision services (AP_AA_CS)	Tags	$AP_AA_CD	Refer to the AP_AA block.
					Genies	$AP_AnalogAcquisition_CG	$AP_AA_CG

* The service is activated by default.

Control Services ($AP_AA_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_AA_CS)*		Corresponding Supervision Templates		Supervision Service Description
Optional Services								
AP_HAL_AI_UC*	AlSignal	$AISignal_UL	Refer to the AISignal block *(see Process Expert , Process Templates User Guide)*.	–	–	–	–	–
	Logic	$AP_HAL_AnalogAcquisition_UL	Refer to the AP_HAL_AnalogAcquisition_UL block *(see page 63)*.	–	–	–	–	–
STD_ZOUT	–	$UEXTRACT_PV_VC	To link with variables that are not of PV_VC type.	–	–	–	–	–

* The service is activated by default.

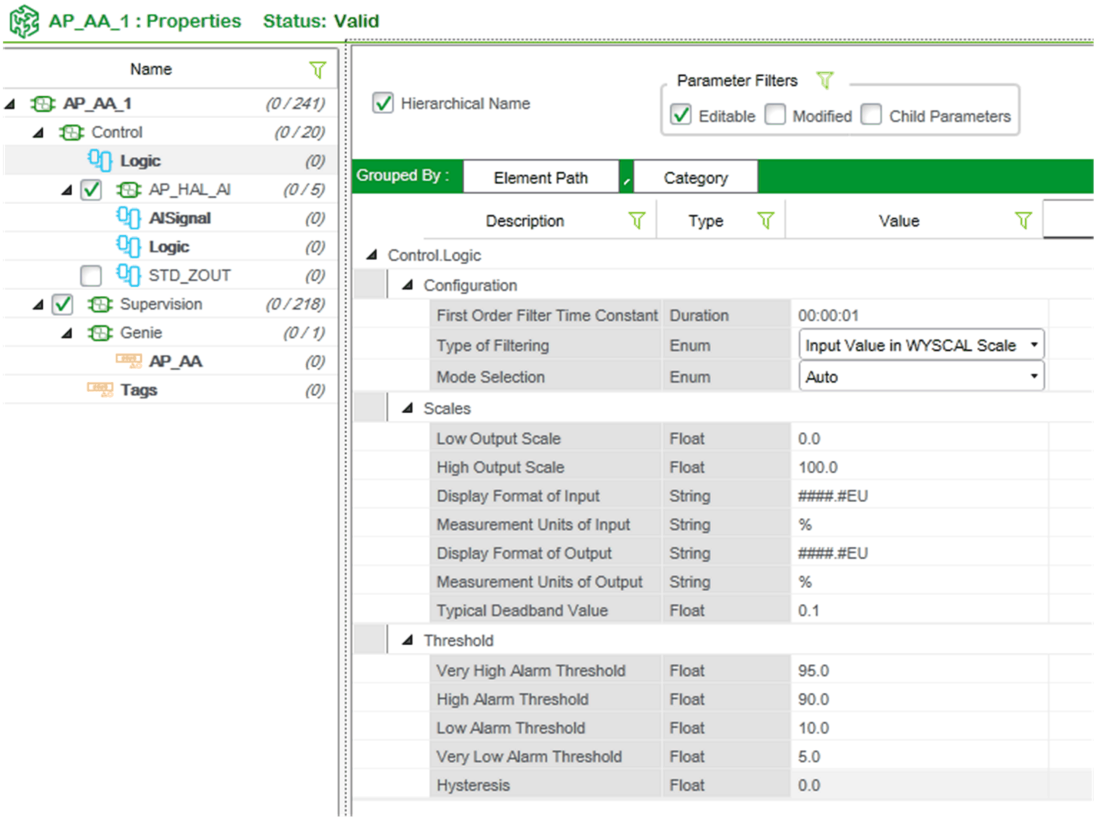
The following figure displays the AP_AA block in Link Editor of PES.



Pin Name	Pin Type	Description
XPVtoVar	Input	Input from variable. Enabled if AP_HAL_AI is deselected.
ZOUT	Output	Output of AP_AA block.
XTRKIN	Input	Tracking input to AP_AA.
XTRKENA	Input	Tracking enable for AP_AA.
IntVar	Input	Int (Integer) type input to AISignal block. Enabled if INT channel data type is selected and AP_HAL_AI is selected.
AINPUTSignalExt	Input	Analog input conditioning signal external. Enabled if data type is INT. Quality signal is selected and AP_HAL_AI is selected.
RealVar	Input	Real type input to AISignal block. Enabled if REAL channel data type is selected and AP_HAL_AI is selected.

Pin Name	Pin Type	Description
VALUE	Output	Real type output. Enabled if STD_ZOUT is selected.
OPRange	Output	Range of output. Enabled if STD_ZOUT is selected.
OPRanged	Output	Ranged value of output. Enabled if STD_ZOUT is selected.

The following figure displays the parameters of AP_AA block.

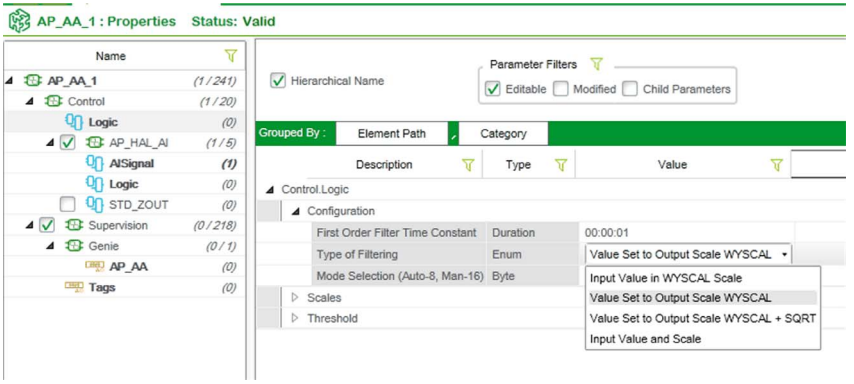


You can modify the parameters in **Configuration**, **Scale**, and **Threshold**.

NOTE: If you enter incorrect scaling values, the block gives unexpected output values.

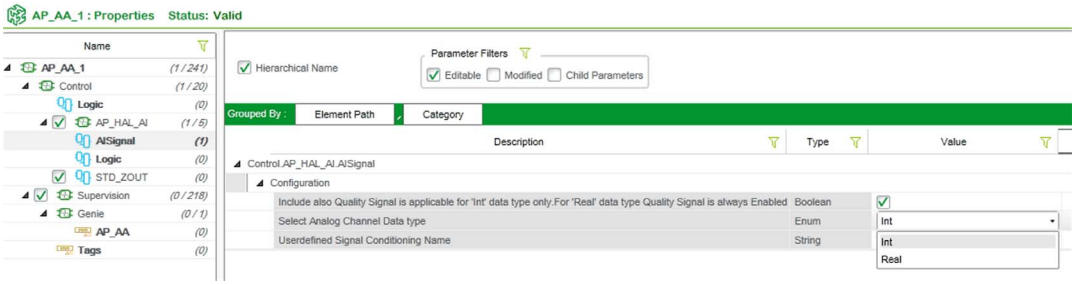
⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Enter the correct scaling values. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

The following figure displays the **Type of Filtering** selection in AP_AA block.



You can select the **Type of Filtering** in AP_AA block from the drop-down menu *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.

The following figure displays the parameters of hardware abstraction layer in AP_AA block.



You can ype of analog channel from the drop-down menu. If the analog channel is of **Int** type, you can select the analog input signal conditioning block for generation. If the analog channel is of **Real** type, the analog input signal conditioning block gets generated. The selection of STD_ZOUT in the left column enables the Real, Range and Ranged type pin. It provides the extracted output from ZOUT pin of AP_AA.

AP_AP: Analog Positioner Block

General Description

The AP_AP process control module is used to interface with an analog output to set up an analog control.

The process template provides simple hardware interface with an analog output.

Composition

The process control module template AP_AP is composed of composite and facet templates, which provide the following services:

Control: Includes core services plus additional, optional services, which you can activate if needed.

Supervision: These services complement the control services. Supervision services are optional.

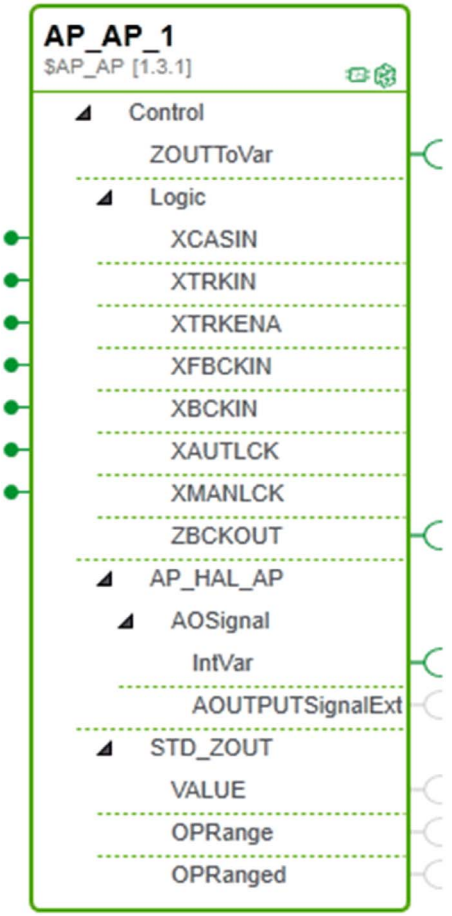
This table describes the services that are available from the AP_AP control module and the corresponding facet, which implements the service:

<table>
<tr><th colspan="2">Control Services ($AP_AP_UC)</th><th>Corresponding Facet Template</th><th>Control Service Description</th><th>Associated Supervision Services ($AP_AP_CS)*</th><th colspan="3">Corresponding Supervision Templates</th><th>Supervision Service Description</th></tr>
<tr><td colspan="9">Core Services</td></tr>
<tr><td rowspan="2">Logic*</td><td rowspan="2">–</td><td rowspan="2">$AP_AP_UL</td><td rowspan="2">Refer to the AP_AP block (see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual).</td><td rowspan="2">Analog positioner supervision services (AP_AP_CS)</td><td>Tags</td><td colspan="2">$AP_AP_CD</td><td rowspan="2">Refer to the AP_AP block.</td></tr>
<tr><td>Genies</td><td>$AP_AnalogPositioner_CG</td><td>$AP_AP_CG</td></tr>
<tr><td colspan="9">* The service is activated by default.</td></tr>
</table>

Control Services ($AP_AP_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_AP_CS)*		Corresponding Supervision Templates		Supervision Service Description
Optional Services								
AP_HAL_AP_UC*	AOSignal	$AOSignal_UL	Refer to the AOSignal block *(see Process Expert , Process Templates User Guide)*.	–	–	–	–	–
	Logic	$AP_HAL_AnalogPositioner_UL	Refer to the AP_HAL_AnalogPositioner_UL block *(see page 64)*.	–	–	–	–	–
STD_ZOUT	–	$UEXTRACT_PV_VC	To link with variables that are not of PV_VC type.	–	–	–	–	–

* The service is activated by default.

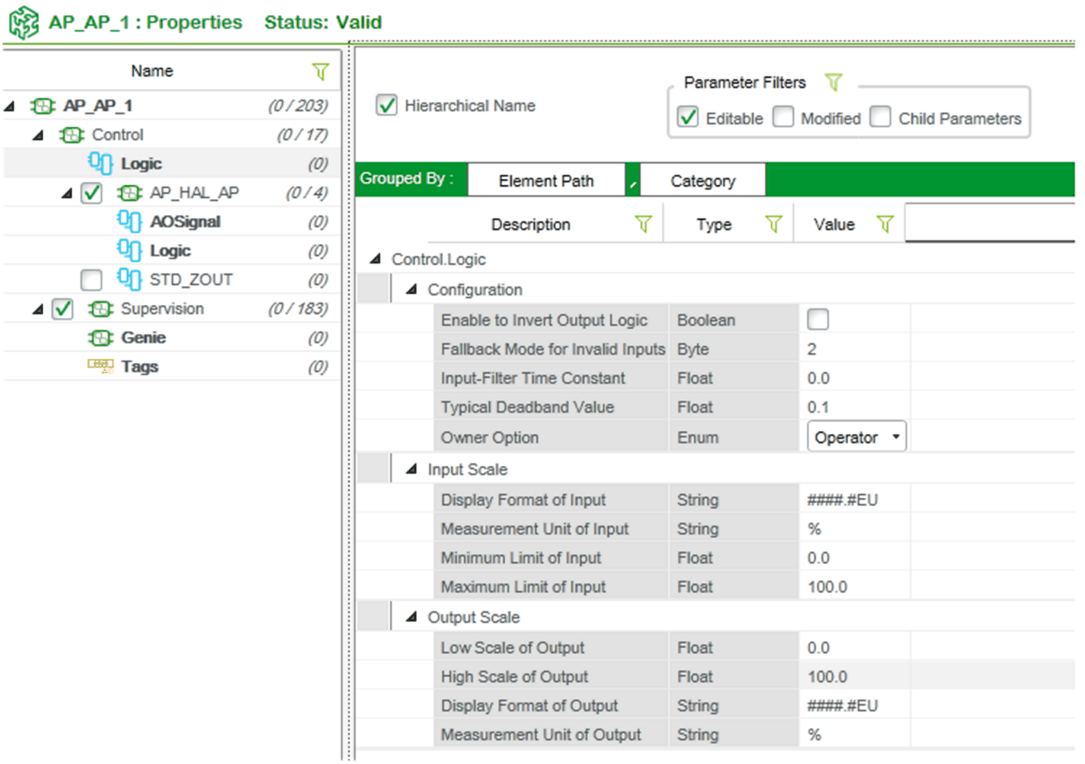
The following figure displays the AP_AP block in Link Editor of PES.



Pin Name	Pin Type	Description
ZOUTtoVar	Output	Output of the block.
XCASIN	Input	Variable input to AP_AP.
XTRKIN	Input	Tracking input to AP_AP.
XTRKENA	Input	Tracking enable for AP_AP.
XFBCKIN	Input	Fallback value.
XBCKIN	Input	Downstream module return signal.
XAUTLCK	Input	Auto mode lock.

Pin Name	Pin Type	Description
XMANLCK	Input	Manual mode lock.
ZBCKOUT	Output	Output to upstream module.
IntVar	Output	Integer type input to AISignal block. Enabled if AP_HAL_AP is selected.
AOUTPUTSignalExt	Output	Analog output conditioning signal external. Enabled quality signal is selected and AP_HAL_AP is selected.
VALUE	Output	**Real** type output. Enabled if STD_ZOUT is selected.
OPRange	Output	Range of output. Enabled if STD_ZOUT is selected.
OPRanged	Output	Ranged value of output. Enabled if STD_ZOUT is selected.

The following figure displays the hardware abstraction layer parameters of AP_AP block.



You can modify the parameters in **Configuration**, **Input Scale**, and **Output Scale.**

NOTE: If you enter incorrect scaling values, the block gives unexpected output values

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Enter the correct scaling values. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

AP_PID: PID Block

General Description

The AP_PID process control module is used to create PID (proportional, integral, and derivative) loops required for regulation.

The PID object is based on a PID algorithm with a mixed structure (series/parallel).

Composition

The process control module template AP_PID is composed of composite and facet templates, which provide the following services:

Control: Includes core services plus additional, optional services, which you can activate if needed.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_PID control module and the corresponding facet, which implements the service:

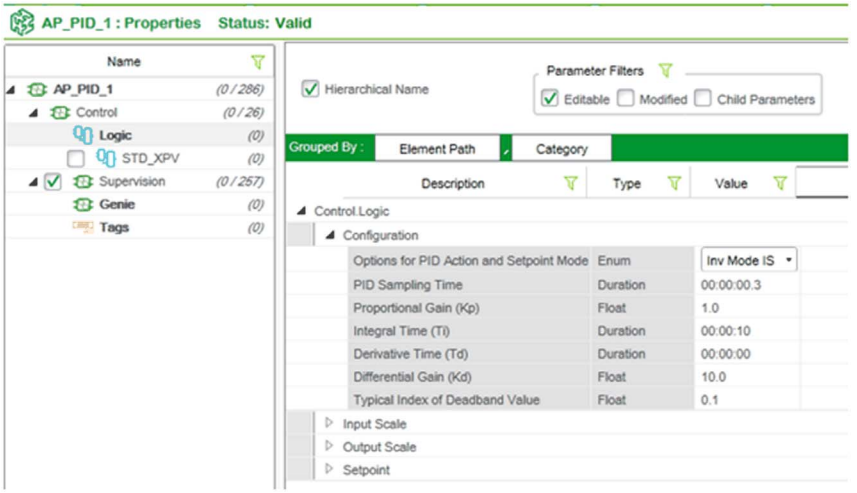
Control Services ($AP_PID_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_PID_CS)*		Corresponding Supervision Templates		Supervision Service Description
Core Services								
Logic*	–	$AP_PID_UL	Refer to the AP_PID block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	PID supervision services (AP_PID_CS)	Tags	$AP_PID_CD		Refer to the AP_PID block.
					Genies	$AP_PID_CG	$AP_PID_Circle	
							$AP_PID_PVSP	
							$AP_PID_PVSPOP	
							$AP_PID_SP	
							$AP_PID_SPOP	
Optional Services								
STD_XPV	–	$UCREATE_PV_VC	To link with variables that are not of PV_VC type.	–	–	–	–	–

* The service is activated by default.

The following figure displays the AP_PID block in Link Editor of PES.

Pin Name	Pin Type	Description
XCASIN	Input	External setpoint.
XPV	Input	Process variable.
XTRKIN	Input	Tracking input to AP_PID.
XTRKENA	Input	Tracking enable for AP_PID.
XBCKIN	Input	Downstream module return signal.
ZOUT	Output	Output of AP_PID block.
ZBCKOUT	Output	Output to upstream module.
PVRanged	Input	Ranged type process variable input. Enabled if STD_XPV is selected.

The following figure displays the parameters of `AP_PID` block.

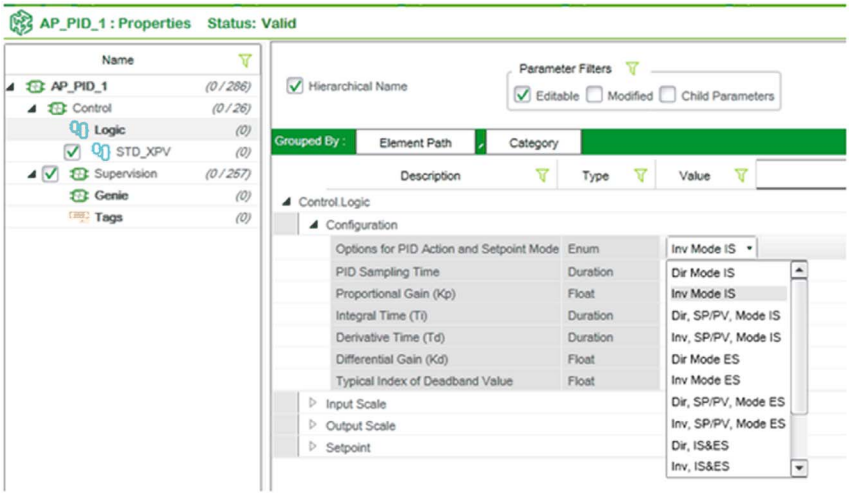


You can modify the parameters in **Configuration**, **Input Scale**, **Output Scale**, and **Setpoint**.

NOTE: If you enter incorrect tuning parameter (proportional gain, integral time, and derivative time) values, the block gives unexpected output and response.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION
Enter correct tuning parameter (proportional gain, integral time, and derivative time) values.
Failure to follow these instructions can result in death, serious injury, or equipment damage.

The following figure displays the selection of mode in AP_PID block.



You can select the mode of operation of AP_PID from the drop-down menu. The selection of STD_XPV in the left column enables the Ranged type pin. It provides input to the XPV pin of the AP_PID DFB. You must connect either to XPV or to the PVRanged pin. If both are connected, the block goes to invalid state.

The PID controller's output ZOUT can only be linked in the following ways:

- Directly to the Analog Positioner(AP_AP) block input
- To the Analog Positioner block via the Choice(AP_CH) block

NOTE: Do not connect blocks other than AP_AP and AP_CH to the output of the PID controller block. If you connect the auxiliary blocks other than AP_CH and AP_AP blocks to the PID controller, it does not function properly and does not give expected result.

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

Connect only auxiliary block AP_CH or AP_AP to the output of the PID controller block.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

To achieve the upstream information transfer to the downstream object feature (Back-in / Back-out):

- Link the XBCKIN pin with the ZBCKOUT pin of AP_AP block (mandatory).
- When the controller output ZOUT is connected to the Analog Positioner block via the choice(AP_CH) block, then the ZBCKOUT pin of the AP_AP block should be connected (linked) to the XBCKIN pin of the AP_CH block and the ZBCKOUT pin of the AP_CH block should be connected (linked) to the XBCKIN pin of the PID Controller Block.
- When the controller output is directly connected to the Analog Positioner block, then the ZBCKOUT pin of the AP_AP block should be connected to the XBCKIN pin of the PID Controller.

AP_EPID: EPID Block

General Description

The AP_EPID process control module is used to create PID (proportional, integral, and derivative) loops requiring regulation using feed-forward input and/or RCPY.

The enhanced PID function block has features, which are required to control the closed control loop. Autotuning functionality is a usable feature that is in-built in this block.

The PID object is based on a PID algorithm with a mixed structure (series/parallel).

Composition

The process control module template AP_EPID is composed of composite and facet templates, which provide the following services:

Control: Includes core services plus additional, optional services, which you can activate if needed.

Supervision: These services complement the control services. Supervision services are optional.

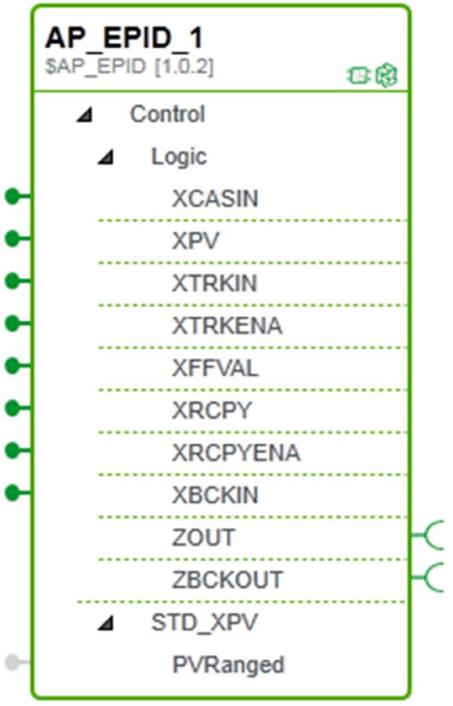
This table describes the services that are available from the AP_EPID control module and the corresponding facet, which implements the service:

Control Services ($AP_EPID_UC)	Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_EPID_CS)*	Corresponding Supervision Templates		Supervision Service Description
Core Services						
Logic*	–	$AP_EPID_UL	EPID supervision services (AP_EPID_CS)	Tags	$AP_EPID_CD	Refer to the AP_EPID block.
				Genies	$AP_EPID_CG	$AP_EPID_Circle
						$AP_EPID_PVSP
						$AP_EPID_PVSPOP
						$AP_EPID_SP
						$AP_EPID_SPOP
		Refer to the AP_EPID block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.				

* The service is activated by default.

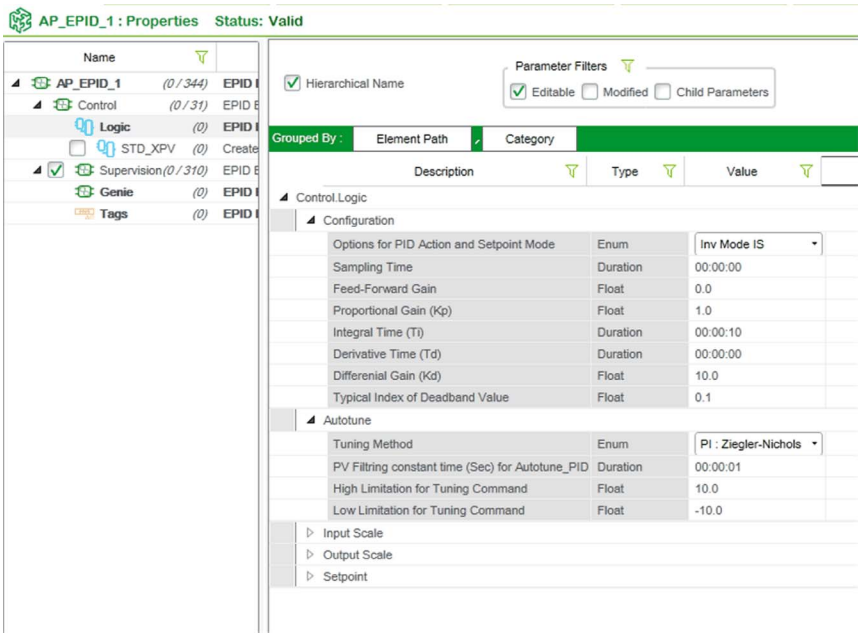
Control Services ($AP_EPID_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_EPID_CS)*		Corresponding Supervision Templates		Supervision Service Description
Optional Services								
STD_XPV	–	$UCREATE_PV_VC	To link with variables that are not of PV_VC type.	–	–	–	–	–
* The service is activated by default.								

The following figure displays the AP_EPID block in Link Editor of PES.



Pin Name	Pin Type	Description
XCASIN	Input	External setpoint.
XPV	Input	Process variable.
XTRKIN	Input	Tracking input to AP_EPID.
XTRKENA	Input	Tracking enable for AP_EPID.
XFFVAL	Input	Feed-forward variable input.
XRCPY	Input	RCPY input.
XRCPYENA	Input	RCPY enable.
XBCKIN	Input	Downstream module return signal.
ZOUT	Output	Output of AP_EPID block.
ZBCKOUT	Output	Output to upstream module.
PVRanged	Input	Ranged type process variable input. Enabled if STD_XPV is selected.

The following figure displays the parameters of AP_EPID block.

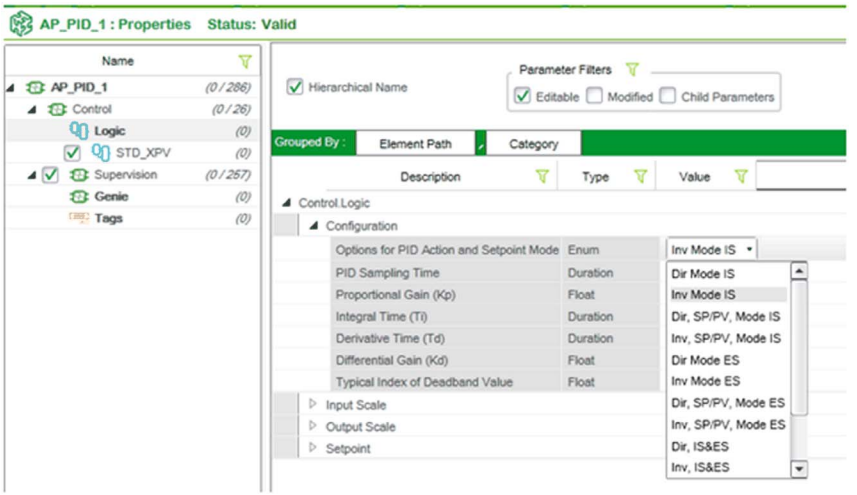


You can modify the parameters in **Configuration**, **Autotune**, **Input Scale**, **Output Scale**, and **Setpoint**.

NOTE: If you enter incorrect tuning parameter (proportional gain, integral time, and derivative time) values, the EPID controller block gives unexpected output and response.

⚠ WARNING
UNINTENDED EQUIPMENT OPERATION Enter correct tuning parameter (proportional gain, integral time, and derivative time) values. **Failure to follow these instructions can result in death, serious injury, or equipment damage.**

The following figure displays the selection of mode in AP_EPID block.



You can select the mode of operation of AP_EPID from the drop-down menu. The selection of STD_XPV in the left column enables the Ranged type pin. It provides input to the XPV pin of the AP_EPID DFB. You must connect either to XPV or to the PVRanged pin. If both are connected, the block goes to invalid state.

The EPID controller's output ZOUT can only be linked in the following ways:

- Directly to the Analog Positioner(AP_AP) block input.
- To the Analog Positioner block via the choice(AP_CH) block.

NOTE: Do not connect blocks other than AP_AP and AP_CH to the output of the EPID controller block. If you connect the auxiliary blocks other than AP_CH and AP_AP blocks to the EPID controller, it does not function properly and does not give expected result

⚠ WARNING

UNINTENDED EQUIPMENT OPERATION

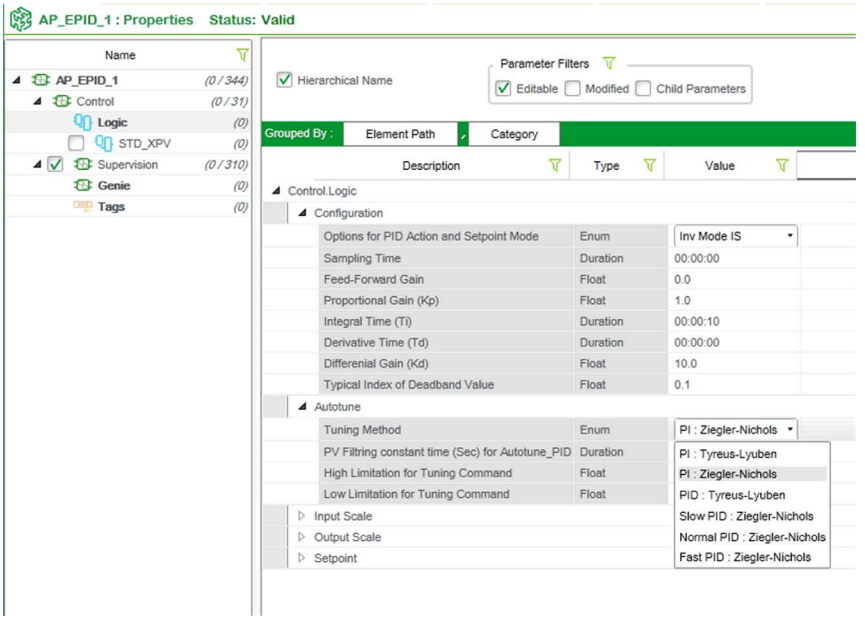
Connect only auxiliary block AP_CH or AP_AP to the output of the EPID controller block.

Failure to follow these instructions can result in death, serious injury, or equipment damage.

To achieve the upstream information transfer to the downstream object feature (Back-in / Back-out):

- Link the XBCKIN pin with the ZBCKOUT pin of AP_AP block (mandatory).
- When the controller output ZOUT is connected to the Analog Positioner block via the choice(AP_CH) block, then the ZBCKOUT pin of the AP_AP block should be connected (linked) to the XBCKIN pin of the AP_CH Block and the ZBCKOUT pin of the AP_CH block should be connected (linked) to the XBCKIN pin of the EPID Controller Block.
- When the Controller's output is directly connected to the Analog Positioner block, then the ZBCKOUT pin of the AP_AP block should be connected to the XBCKIN pin of the EPID Controller.

The following figure displays the selection of **Tuning Method** in AP_EPID block.



You can select the tuning method of AP_EPID from the drop-down menu.

AP_FSP: Setpoint Block

General Description

The AP_FSP process control module is used to create a setpoint.

The process template provides a setpoint, which is filtered and limited to obtain a bumpless downstream output.

Composition

The process control module template AP_FSP is composed of composite and facet templates, which provide the following services:

Control: Includes core services plus additional, optional services, which you can activate if needed

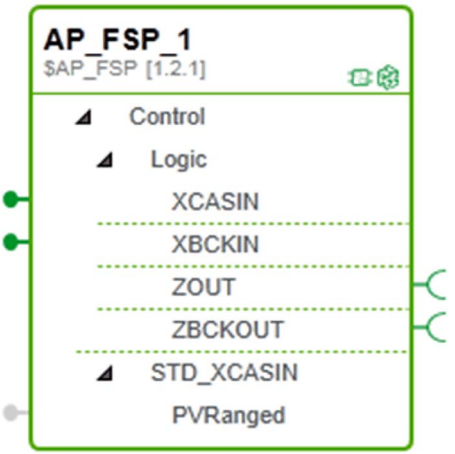
Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_FSP control module and the corresponding facet, which implements the service:

Control Services ($AP_FSP_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_FSP_CS)*		Corresponding Supervision Templates		Supervision Service Description
Core Services								
Logic*	–	$AP_FSP_UL	Refer to the AP_FSP block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Setpoint supervision services (AP_FSP_CS)	Tags	$AP_FSP_CD		Refer to the AP_FSP block.
					Genies	$AP_Setpoint_CG	$AP_FSP_CG	
Optional Services								
STD_XCASIN	–	$UCREATE_PV_VC	To link with variables that are not of PV_VC type.	–	–	–	–	–

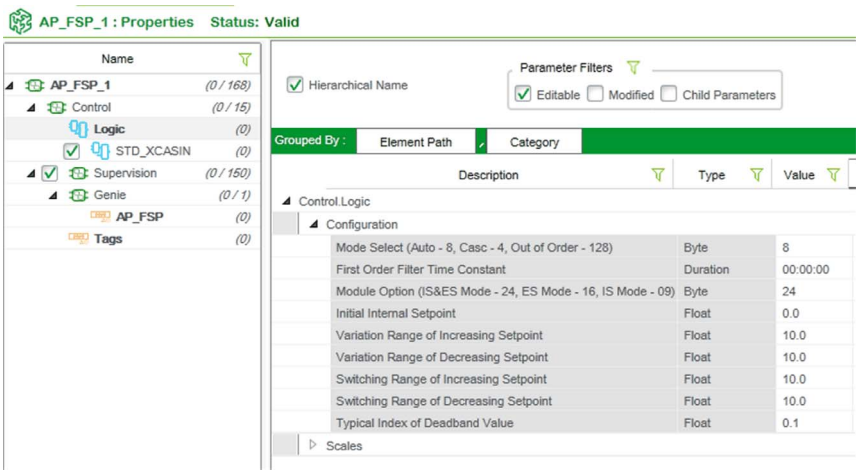
* The service is activated by default.

The following figure displays the AP_FSP block in link editor of PES.



Pin Name	Pin Type	Description
XCASIN	Input	External setpoint.
XBCKIN	Input	Downstream module return signal.
ZOUT	Output	Output of AP_FSP block.
ZBCKOUT	Output	Output to upstream module.
PVRanged	Input	Ranged type process variable input. Enabled if STD_XCASIN is selected.

The following figure displays the parameters of AP_FSP block.



You can modify the parameters in **Configuration**, **Input Scale**, **Output Scale**, and **Setpoint** . The selection of STD_XCASIN in the left column enables the Ranged type pin. It provides input to the XCASIN pin of the AP_FSP DFB. You must connect either to XCASIN or to the PVRanged pin. If both are connected, the block goes to invalid state.

AP_CH: Choice Block

General Description

The AP_CH process control module is used to select 1 of 4 input signals. Transitions from one channel to another are bumpless.

Composition

The process control module template AP_CH is composed of composite and facet templates, which provide the following services:

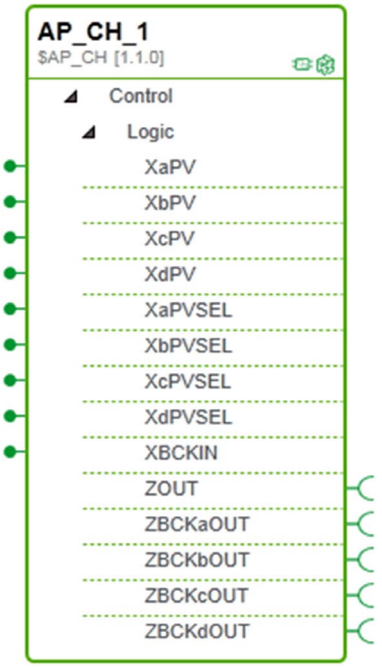
Control: Includes core services.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_CH control module and the corresponding facet, which implements the service:

<table>
<tr><th colspan="2">Control Services ($AP_CH_UC)</th><th>Corresponding Facet Template</th><th>Control Service Description</th><th>Associated Supervision Services ($AP_CH_CS)*</th><th colspan="2">Corresponding Supervision Templates</th><th>Supervision Service Description</th></tr>
<tr><td colspan="8">Core Services</td></tr>
<tr><td rowspan="2">Logic*</td><td rowspan="2">–</td><td rowspan="2">$AP_CH_UL</td><td rowspan="2">Refer to the AP_CH block (see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual).</td><td rowspan="2">Selection supervision services (AP_CH_CS)</td><td>Tags</td><td colspan="2">$AP_CH_CD</td><td rowspan="2">Refer to the AP_CH block.</td></tr>
<tr><td>Genies</td><td>$AP_Choice_CG</td><td>$AP_CH_CG</td></tr>
<tr><td colspan="8">* The service is activated by default.</td></tr>
</table>

The following figure displays the AP_CH block in Link Editor of PES.



Pin Name	Pin Type	Description
XaPV	Input	Process variable for channel A.
XbPV	Input	Process variable for channel B.
XcPV	Input	Process variable for channel C.
XdPV	Input	Process variable for channel D.
XaPVSEL	Input	Channel A selection.
XbPVSEL	Input	Channel B selection.
XcPVSEL	Input	Channel C selection.
XdPVSEL	Input	Channel D selection.
XBCKIN	Input	Downstream module return signal.
ZOUT	Output	Output of AP_CH.
ZBCKaOUT	Output	Output to upstream module A.
ZBCKbOUT	Output	Output to upstream module B.
ZBCKcOUT	Output	Output to upstream module C.
ZBCKdOUT	Output	Output to upstream module D.

AP_DM: Demultiplexer Block

General Description

The AP_DM process control module is used to send **SP** signal to a number of different control modules.

Composition

The process control module template AP_DM is composed of composite and facet templates, which provide the following services:

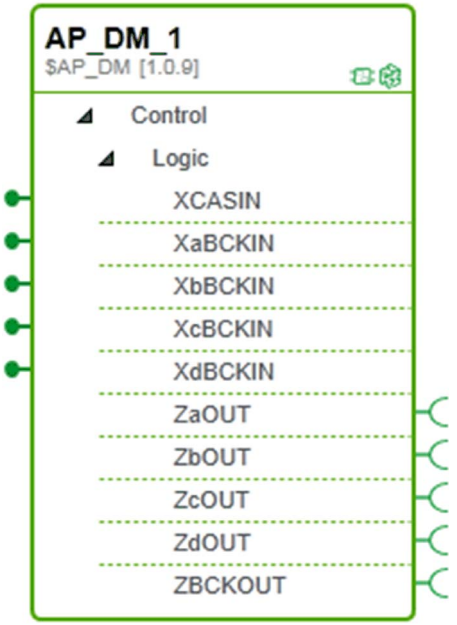
Control: Includes core services.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_DM control module and the corresponding facet, which implements the service:

Control Services ($AP_DM_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_DM_CS)*		Corresponding Supervision Templates		Supervision Service Description
Core Services								
Logic*	–	$AP_DM_UL	Refer to the AP_DM block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Demultiplexer supervision services (AP_DM_CS)	Tags	$AP_DM_CD		Refer to the AP_DM block.
					Genies	$AP_Demultiplexer_CG	$AP_DM_CG	
* The service is activated by default.								

The following figure displays the AP_DM block in Link Editor of PES.



Pin Name	Pin Type	Description
XCASIN	Input	Block setpoint.
XaBCKIN	Input	Return signal downstream module A.
XbBCKIN	Input	Return signal downstream module B.
XcBCKIN	Input	Return signal downstream module C.
XdBCKIN	Input	Return signal downstream module D.
ZaOUT	Output	SP of first measurement.
ZbOUT	Output	SP of second measurement.
ZcOUT	Output	SP of third measurement.
ZdOUT	Output	SP of fourth measurement.
ZBCKOUT	Output	Output to upstream module.

AP_RATIO: RATIO Block

General Description

The ratio function block is a ratio or proportional regulation object in which a physical value proportionately controls a secondary physical value.

Composition

The process control module template AP_RATIO is composed of composite and facet templates, which provide the following services:

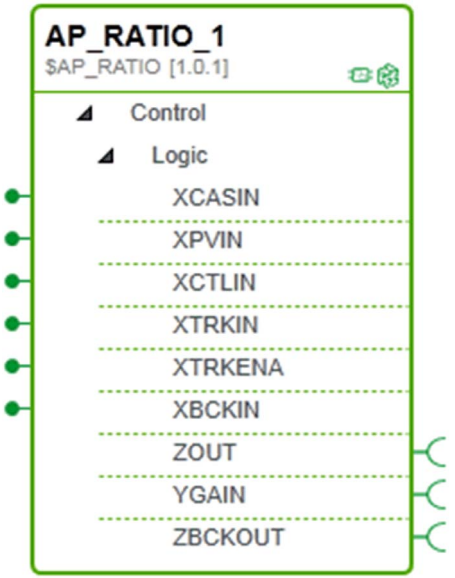
Control: Includes core services.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_RATIO control module and the corresponding facet, which implements the service:

Control Services ($AP_RATIO_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_RATIO_CS)*	Corresponding Supervision Templates		Supervision Service Description
Core Services							
Logic*	–	$AP_RATIO_UL	Refer to the AP_RATIO block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Ratio supervision services (AP_RATIO_CS)	Tags	$AP_RATIO_CD	Refer to the AP_RATIO block.
					Genies	$AP_RATIO_CG	$AP_RAT_CG
* The service is activated by default.							

The following figure displays the AP_RATIO block in Link Editor of PES.



Pin Name	Pin Type	Description
XCASIN	Input	External setpoint.
XPVIN	Input	Process value input.
XCTLIN	Input	Input for ratio calculation.
XTRKIN	Input	Tracking input to AP_RATIO.
XTRKENA	Input	Tracking enable for AP_RATIO.
ZOUT	Output	Output AP_RATIO.
YGAIN	Output	Real ratio co-efficient.
ZBCKOUT	Output	Output to upstream module.

AP_VOTE: Vote Block

General Description

You can use the AP_VOTE process control module is used to calcutate the mean of 3 process variables.

Composition

The process control module template AP_VOTE is composed of composite and facet templates, which provide the following services:

Control: Includes core services.

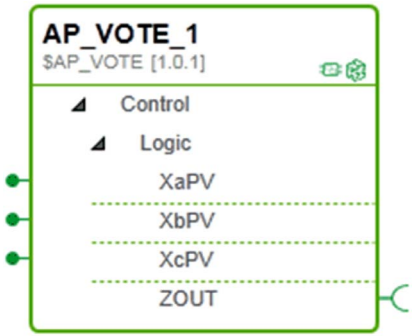
Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_VOTE control module and the corresponding facet, which implements the service:

Control Services ($AP_VOTE_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_VOTE_CS)*	Corresponding Supervision Templates		Supervision Service Description
Core Services							
Logic*	–	$AP_VOTE_UL	Refer to the AP_VOTE block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Vote supervision services (AP_VOTE_CS)	Tags	$AP_VOTE_CD	Refer to the AP_VOTE block.
					Genies	$AP_VOTE_CG	$AP_VOT_CG

* The service is activated by default.

The following figure displays the AP_VOTE block in Link Editor of PES.



Pin Name	Pin Type	Description
XaPV	Input	Process variable for channel A.
XbPV	Input	Process variable for channel B.
XcPV	Input	Process variable for channel C.
ZOUT	Output	Output of AP_VOTE.

AP_SEL: Selection Block

General Description

You can use the AP_SEL control module to select a setpoint among 3 signals or to calculate the mean value of the 3 signals.

Composition

The process control module template AP_SEL is composed of composite and facet templates, which provide the following services:

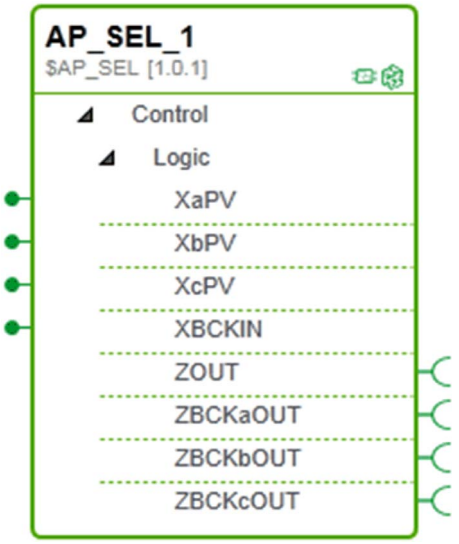
Control: Includes core services.

Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_SEL control module and the corresponding facet, which implements the service:

Control Services ($AP_SEL_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_SEL_CS)*		Corresponding Supervision Templates		Supervision Service Description
Core Services								
Logic*	–	$AP_SEL_UL	Refer to the AP_SEL block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Selection supervision services (AP_SEL_CS)	Tags	$AP_SEL_CD		Refer to the AP_SEL block
					Genies	$AP_Selection_CG	$AP_SEL_CG	
* The service is activated by default.								

The following figure displays the AP_SEL block in Link Editor of PES.



Pin Name	Pin Type	Description
XaPV	Input	Process variable for channel A.
XbPV	Input	Process variable for channel B.
XcPV	Input	Process variable for channel C.
XBCKIN	Input	Downstream module return signal.
ZOUT	Output	Output of AP_SEL.
ZBCKaOUT	Output	Output to upstream module A.
ZBCKbOUT	Output	Output to upstream module B.
ZBCKcOUT	Output	Output to upstream module C.

AP_SPLIT: Split Block

General Description

The AP_SPLIT control module transforms an analog input value into 2 analog outputs using the coordinate values.

Composition

The process control module template AP_SPLIT is composed of composite and facet templates, which provide the following services:

Control: Includes core services.

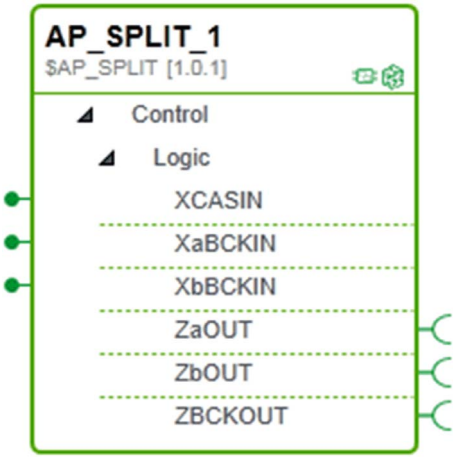
Supervision: These services complement the control services. Supervision services are optional.

This table describes the services that are available from the AP_SPLIT control module and the corresponding facet, which implements the service:

Control Services ($AP_SPLIT_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services ($AP_SPLIT_CS)*	Corresponding Supervision Templates		Supervision Service Description
Core Services							
Logic*	–	$AP_SPLIT_UL	Refer to the AP_SEL block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.	Split supervision services (AP_SPLIT_CS)	Tags	$AP_SPLIT_CD	Refer to the AP_SPLIT block.
					Genies	$AP_SPLIT_CG	$AP_SPL_CG

* The service is activated by default.

The following figure displays the AP_SPLIT block in Link Editor of PES.



Pin Name	Type of Pin	Description
XaPV	Input	Process variable for channel A.
XaBCKIN	Input	Return signal downstream module A.
XbBCKIN	Input	Return signal downstream module B.
ZaOUT	Output	Output A.
ZbOUT	Output	Output B.
ZBCKOUT	Output	Output to upstream module.

AP_WRAP_AP: Wrapper for Analog Positioner Block

General Description

The AP_WRAP_AP block is used for linking the analog actuators of other library without losing the key feature of APC library between a upstream object communicating with a downstream object.

Composition

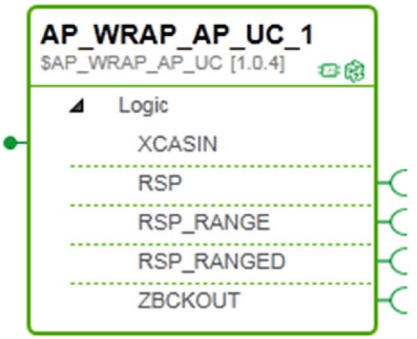
The process control module template AP_WRAP_AP is composed of composite and facet templates, which provide the following services.

Control: Includes core services.

This table describes the services that are available from the AP_WRAP_AP control module and the corresponding facet, which implements the service:

Control Services ($AP_WRAP_AP_UC)		Corresponding Facet Template	Control Service Description	Associated Supervision Services		Corresponding Supervision Templates		Supervision Service Description
Core Services								
Logic*	–	$AP_WRAP_AP_UL	Refer to the AP_WRAP_AP block.	–	–	–		–
					–	–	–	
* The service is activated by default.								

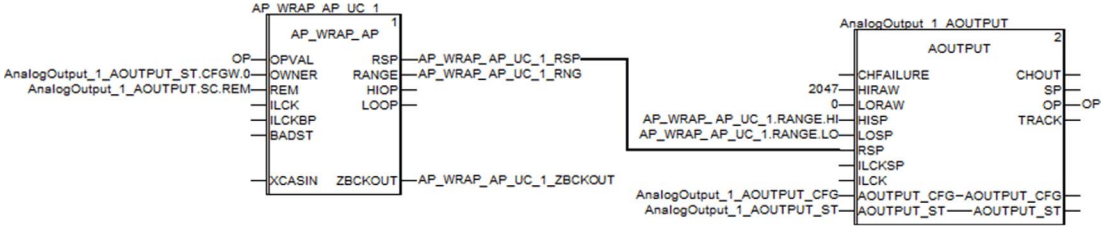
The following figure displays the AP_WRAP_AP block in Link Editor of PES.



Pin Name	Type of Pin	Description
XCASIN	Input	Variable input to AP_WRAP_AP.
RSP	Output	Output real value.
RSP_RANGE	Output	Output range value.
RSP_RANGED	Output	Output ranged value.
ZBCKOUT	Output	Output to upstream module.

The block is an example of the linking of AP_WRAP_AP block with the AOUTPUT block fom GPL library.

The user has to link the input pins (except XCASIN) depending on the requirement.



Section 4.2
Hardware Abstraction Layer Templates (Signal Objects)

Overview

This chapter describes the Hardware Abstraction Layer Templates.

There are 2 Unity Composite and 2 Unity Logic templates for Hardware Abstraction Layer blocks. The templates are as follows:

- AP_HAL_AI_UC
- AP_HAL_AP_UC
- AP_HAL_AnalogAcquisition_UL
- AP_HAL_AnalogPositioner_UL

What Is in This Section?

This section contains the following topics:

Topic	Page
AP_HAL_AI_UC	61
AP_HAL_AP_UC	62
AP_HAL_AnalogAcquisition_UL	63
AP_HAL_AnalogPositioner_UL	64

AP_HAL_AI_UC

General Description

This template is used as Hardware Abstraction Layer for Analog Acquisition block template.

Composition

This template AP_HAL_AI_UC is composed of AISignal_UL template of General Purpose library and AP_HAL_AnalogAcquisition_UL facet templates. The AISignalCond DFB is generated only if the quality signal is included (that is, Type = True); otherwise, only AP_HAL_AI DFB is generated. This Unity Composite is included in the Analog Acquistion block, which is an optional service in it.

Reference

Refer to the AISignal_UL block *(see Process Expert , Process Templates User Guide)*.

AP_HAL_AP_UC

General Description

This template is used as Hardware Abstraction Layer for Analog Positioner block template.

Composition

This template AP_HAL_AP_UC is composed of AOSignal_UL template of General Purpose library and AP_HAL_AnalogPositioner_UL facet templates. The AOSignalCond DFB is generated only if the quality signal is included (that is, Type = True); otherwise, only AP_HAL_AP DFB is generated with a MOVE block. This Unity Composite is included in the Analog Positioner block, which is an optional service in it.

Reference

Refer to the AOSignal_UL block *(see Process Expert , Process Templates User Guide)*.

AP_HAL_AnalogAcquisition_UL

General Description

This Unity Logic template is used in the Unity Composite of AP_HAL_AI_UC template. You have to enter the high PV, low PV, high raw, and low raw values in the parameters given in this template.

Reference

For more details on the derived function block of this template, refer to the AP_HAL_AI block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.

AP_HAL_AnalogPositioner_UL

General Description

This Unity Logic template is used in the Unity Composite of AP_HAL_AP_UC template. You have to enter the high raw and low raw values in the parameters given in this template.

Reference

For more details on the derived function block of this template, refer to the AP_HAL_AP block *(see Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual)*.

Section 4.3
Structure Data Type Template

Overview

This chapter describes the structure data type templates.

There are 3 Unity logic templates for structure data type that are widely used in this library. Thesse are mentioned as follows:

- PV_VC_UL
- UCREATE_PV_VC_UL
- UEXTRACT_PV_VC_UL

What Is in This Section?

This section contains the following topics:

Topic	Page
PV_VC_UL	66
UCREATE_PV_VC_UL	67
UEXTRACT_PV_VC_UL	68

PV_VC_UL

General Description

This Unity Logic template is created for PV_VC structure data type, which is widely used in this library. This template is used for creating a free variable in the PES. You can enter the default value, maximum range, minimum range, status, and memory address (optional) in the configuration parameters given in this template.

Reference

For more details on the derived data type of this template (that is, PV_VC), refer to the *Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual*.

The following figure displays the PV_VC_UL block in Link Editor of PES.

Pin Name	Pin Type	Description
OUT	Output	Output of type PV_VC.

When you create a variable of type PV_VC, assign **128** to the child element Status in the refine mode of the controller project as shown in the figure:

PV_VC_UL_1	PV_VC			
Value	REAL		0.0	Analogic value
U100	REAL		100.0	Max range
U0	REAL		0.0	Min range
Status	BYTE		128	Value status
Res01	BYTE			Reserved Byte 01
Res02	BYTE			Reserved Byte 02
Res03	BYTE			Reserved Byte 03

UCREATE_PV_VC_UL

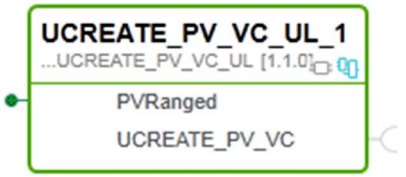
General Description

This Unity Logic template is created for UCREATE_PV_VC elementary function, which is used to pack the default value, maximum range, minimum range, and status from PV_VC type variable.

Reference

For more details on the derived data type of this template (that is, UCREATE_PV_VC), refer to the *Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual*.

The following figure displays the UCREATE_PV_VC_UL block in Link Editor of PES.



Pin Name	Pin Type	Description
PVRanged	Input	Ranged type input.
UCREATE_PV_VC	Output	Output of PV_VC type. It is enabled on connecting the PVRanged pin.

UEXTRACT_PV_VC_UL

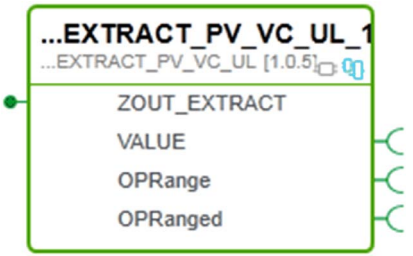
General Description

This Unity Logic template is created for UEXTRACT_PV_VC elementary function, which is used to extract the default value, maximum range, minimum range, and status from PV_VC type variable.

Reference

For more details on the derived data type of this template (that is, UEXTRACT_PV_VC), refer to the *Advanced Process Control Library V2.0, APC Standard Library, PES Control and Supervision Services Offer User Manual*.

The following figure displays the UEXTRACT_PV_VC_UL block in Link Editor of PES.



Pin Name	Pin Type	Description
XCASIN	Input	Input of PV_VC type.
VALUE	Output	Real type output.
OPRange	Output	Range type output.
OPRanged	Output	Ranged type output.

Chapter 5
Use Case Examples

What Is in This Chapter?

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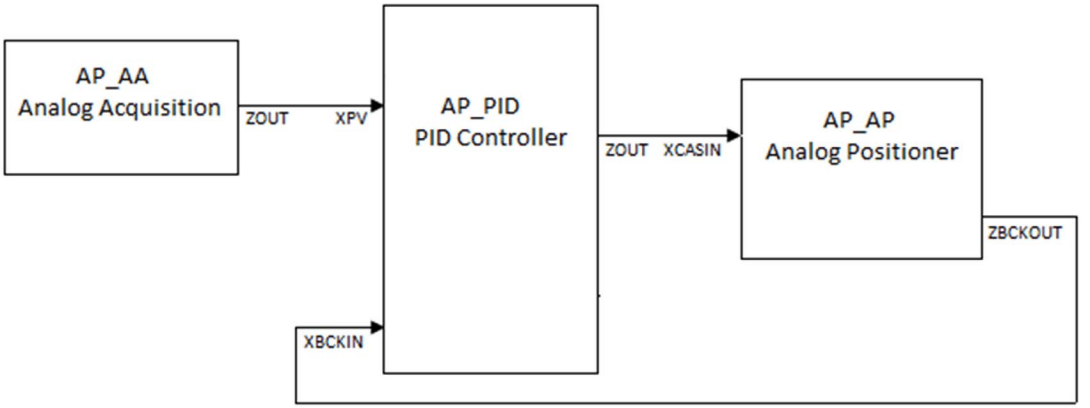
Use Case Example1

Overview

This section describes the different loops that can be implemented using APC Standard Library blocks in various scenarios.

Basic EPID/PID Loop

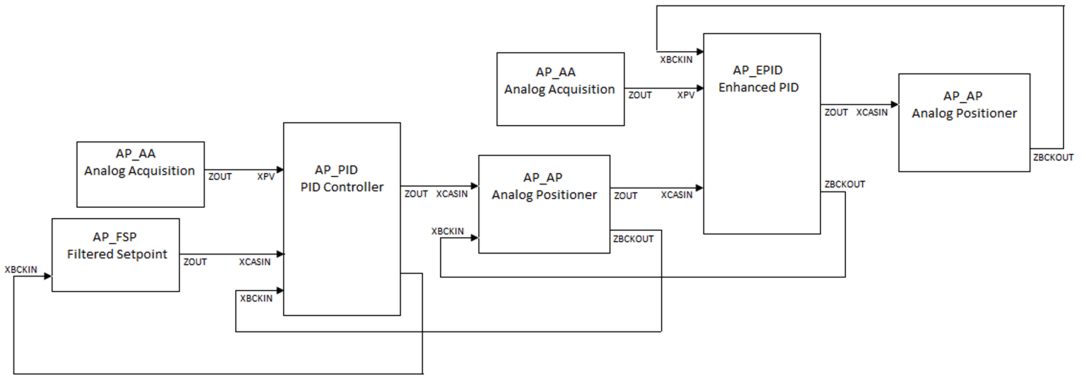
The following figure describes the usage of basic EPID/PID loop:



Use Case Example 2

Cascade PID/EPID Loop

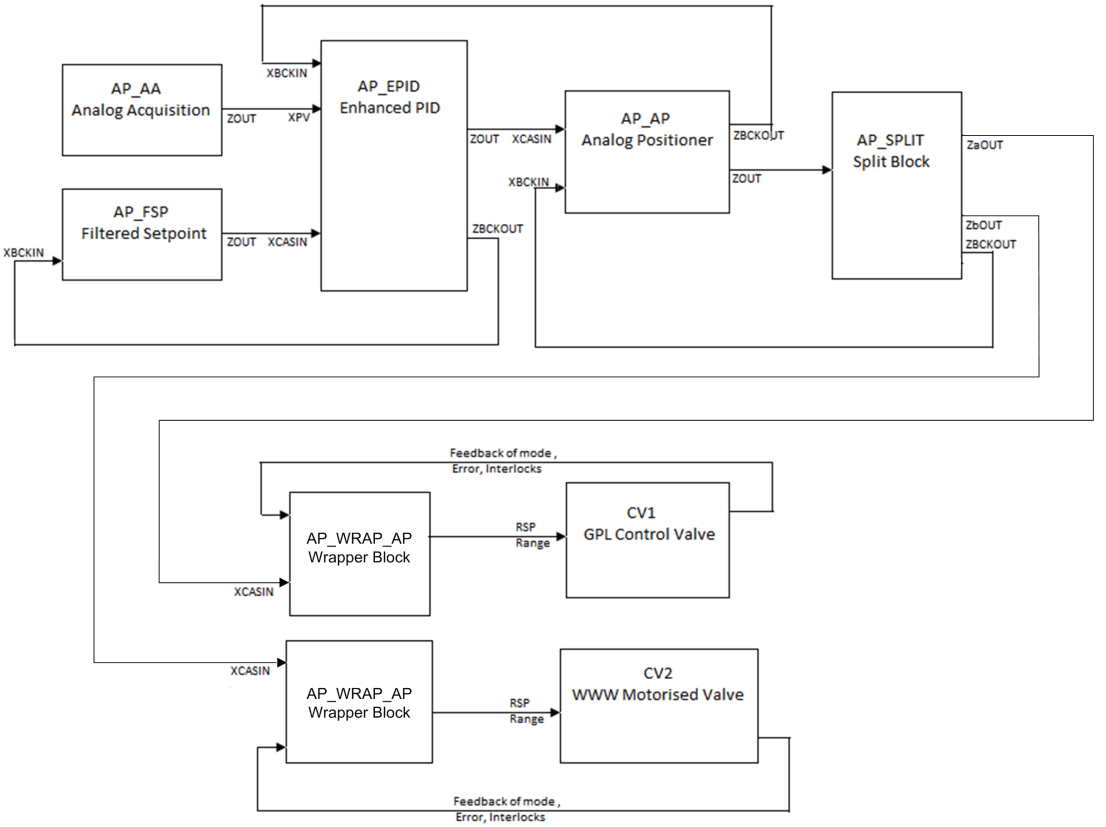
The following figure describes the usage of Cascade PID/EPID loop with multiple controller using Choice block:



Use Case Example 3

PID/EPID Loop Interfaced with Other Library Instances

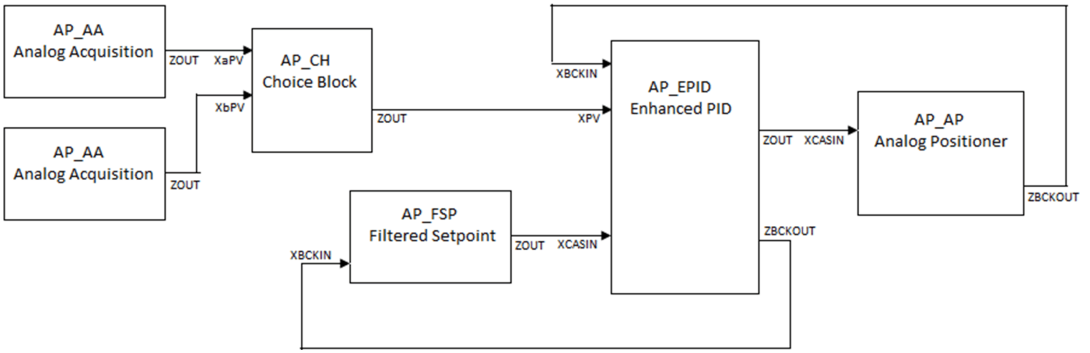
The following figure describes the usage of PID/EPID loop interfaced with other library instances:



Use Case Example 4

PID/EPID Loop with Multiple Input Instances Using Choice Block

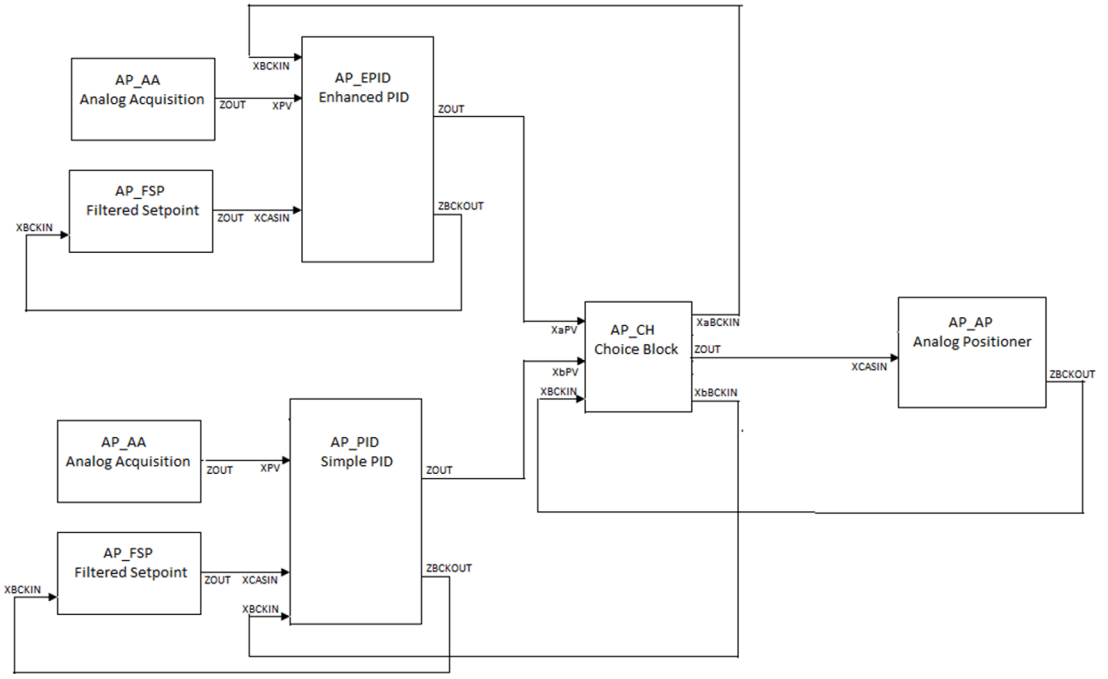
The following figure describes the usage of PID/EPID loop with multiple input instances using Choice block:



Use Case Example 5

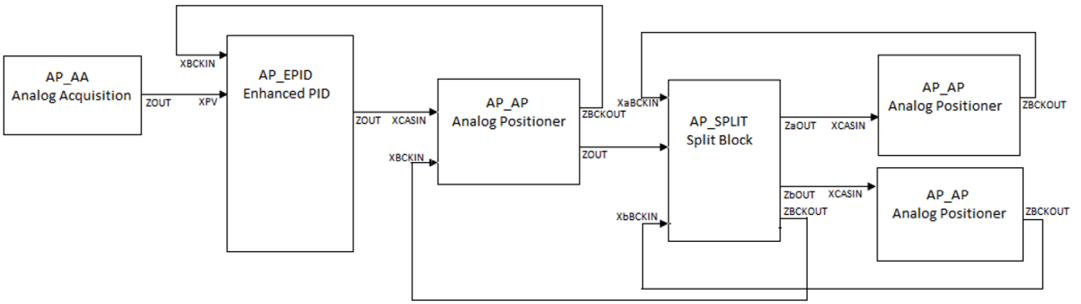
PID/EPID Loop with Multiple Controller Using Choice Block

The following figure describes the usage of PID/EPID loop with multiple controller using Choice block:



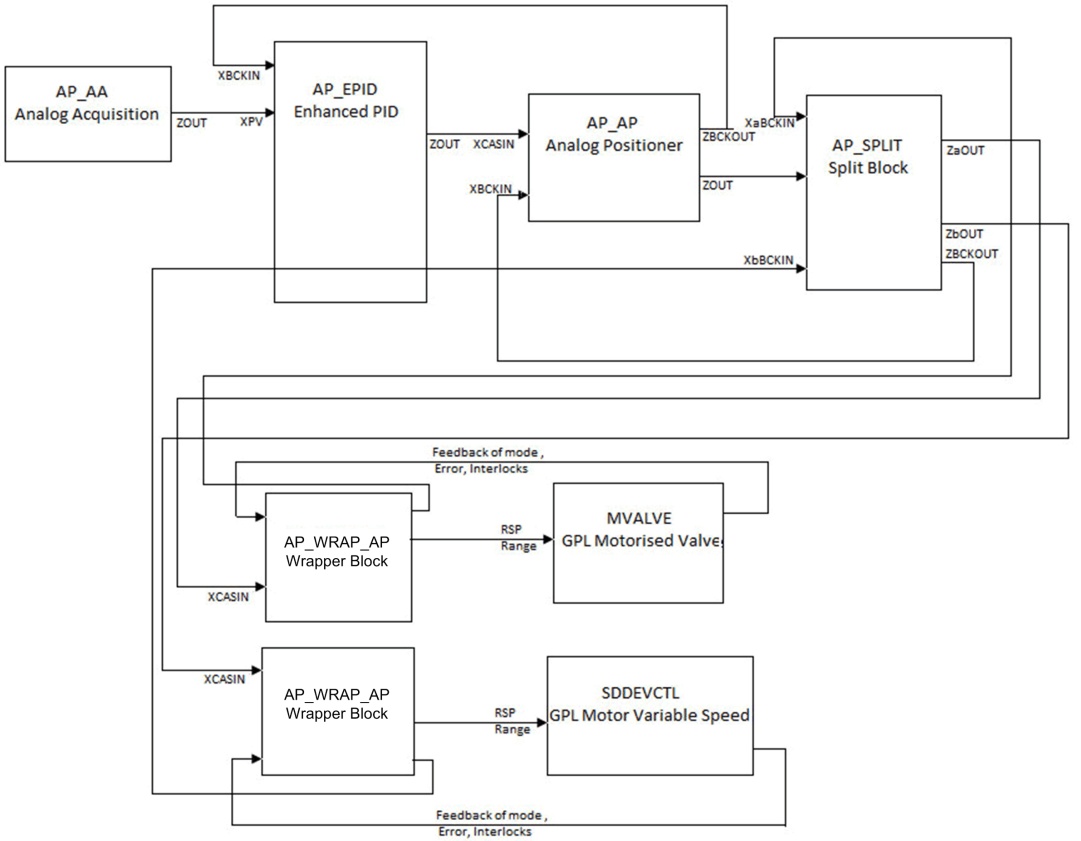
Use Case Example 6

Split Block With Analog Positioner



Use Case Example 7

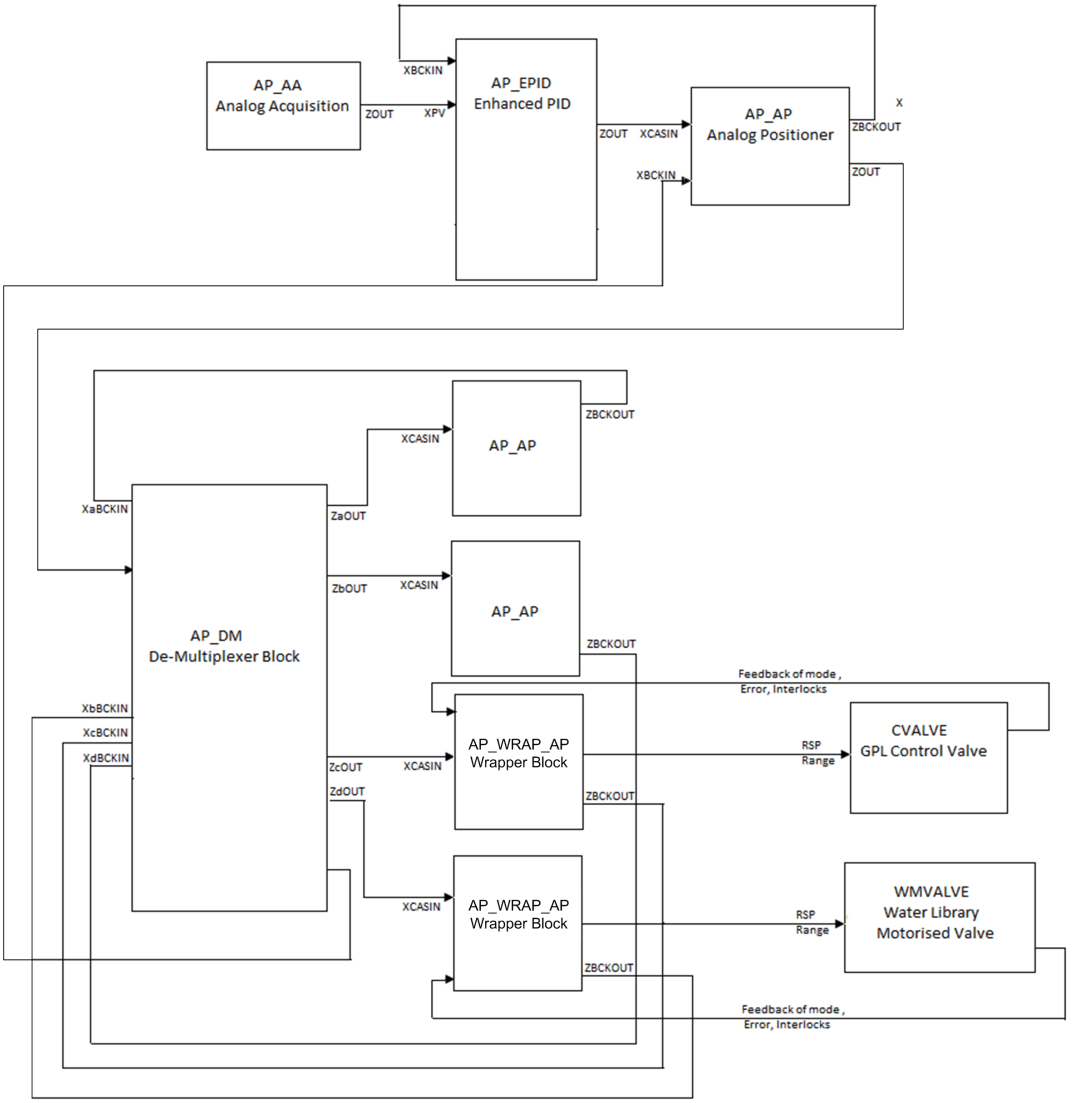
Split Block with Actuators of other libraries



Use Case Example 8

Demultiplexer Loop

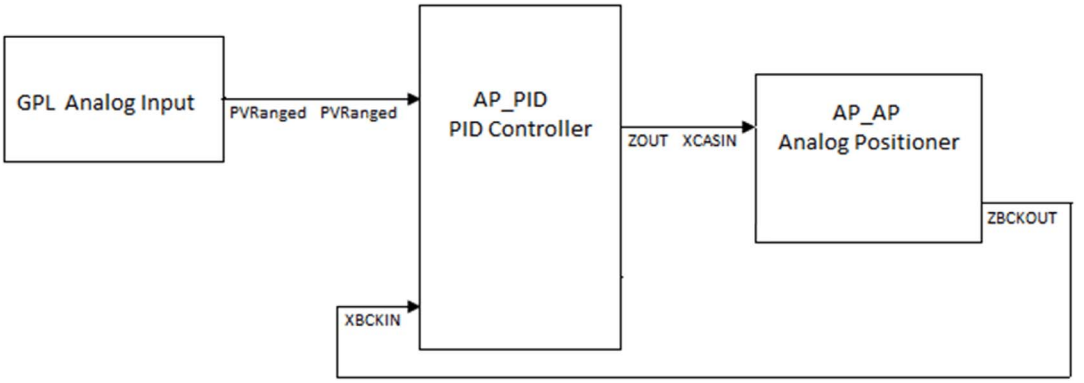
The following figure describes the usage of Demultiplexer loop with multiple controller using Choice block:



Use Case Example 9

PID/EPID Loop with Analog Input from GPL

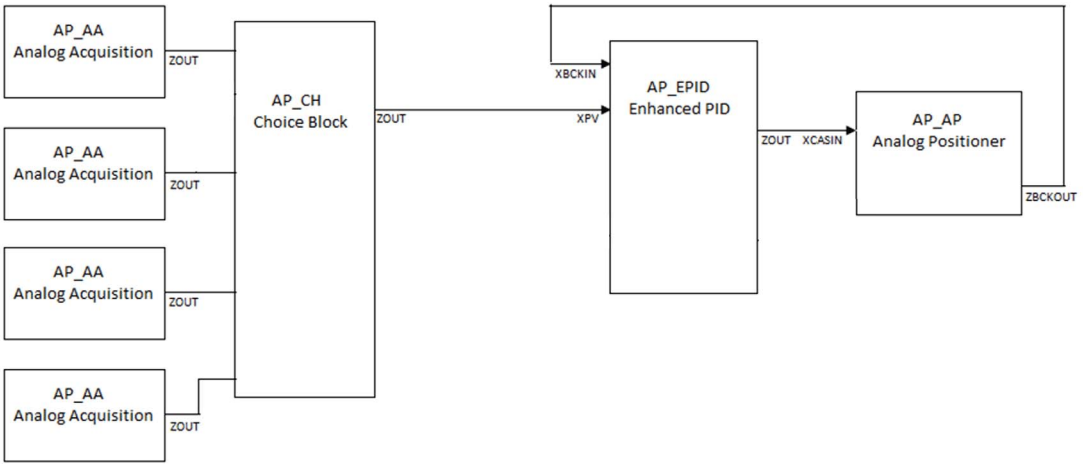
The following figure describes the usage of PID/EPID loop with Analog Input from GPL using Choice block:



Use Case Example 10

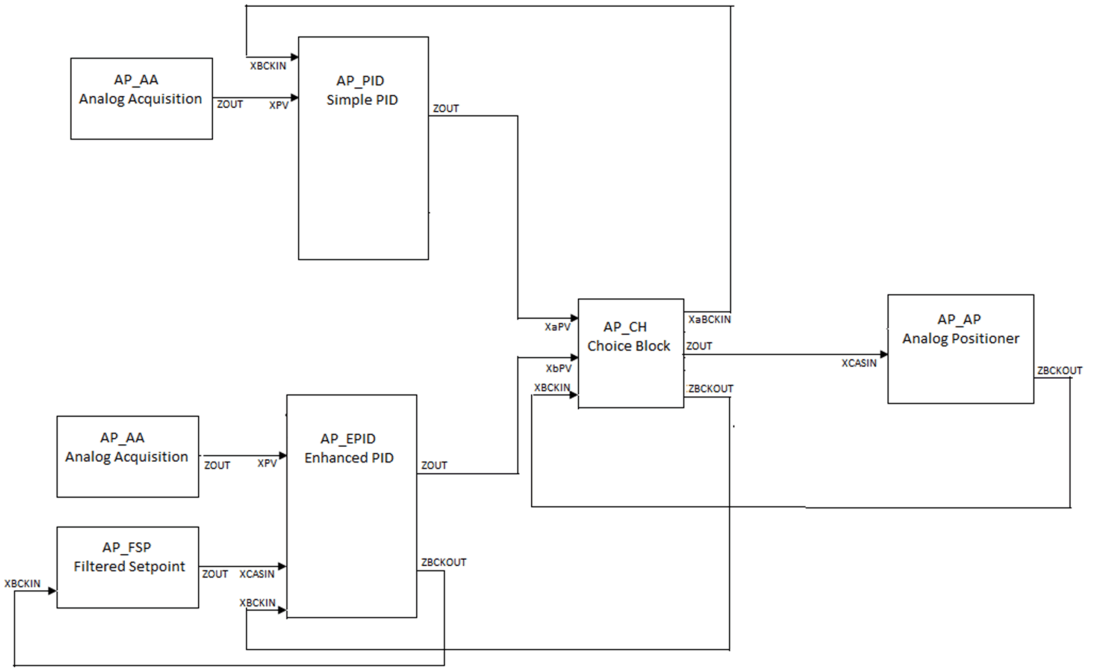
PID/EPID Loop with multiple input instances using Choice Block

The following figure describes the usage of PID/EPID loop with multiple controller using Choice block:



Use Case Example 11

PID/EPID Loop with multiple controller using Choice Block



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